Original Article

Current practice and perceptions of multiparametric magnetic resonance imaging and multiparametric ultrasound and prostatic biopsies for prostate cancer diagnosis in China: a nationwide survey

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Background: Recently, multiparametric magnetic resonance imaging (mpMRI) and multiparametric ultrasound (mpUS) have been developed to improve prostate cancer (PCa) detection. This study aimed to investigate practice patterns and perceptions among clinicians regarding the use of mpMRI and mpUS as well as prostatic biopsies for PCa diagnosis.

Methods: We conducted a national survey via an online questionnaire among urologists, radiologists, and sonographers. The survey collected information on participants' knowledge, routine practices, and perceptions of prostate mpMRI and mpUS, as well as prostatic biopsies. Univariable and multivariable logistic regression analyses were used to identify specialists' characteristics associated with survey responses.

Results: There were 354 responses from 144 hospitals were received. The majority (71.4%) of participants performed mpMRI for PCa diagnosis, while a small proportion (15.3%) of them used mpUS. The transperineal ultrasound-guided approach for systematic prostate biopsy was considered as preferable (47.2%). For targeted biopsy, cognitive fusion imaging (71.2%) and MRI-US fusion imaging (62.1%) were clearly favored. Compared with participants in community practices and from central-west region of China, those in academic practices and from east region of China were more likely to report utilization of mpMRI [odds ratio (OR) =2.08 and OR =0.19] and mpUS (OR =0.04 and OR =0.33) and recommendation of MRI targeted biopsy (OR =1.50 and OR =0.15) (P<0.05 in all).

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Conclusions: The majority of specialists perceived that mpMRI was routinely used, while only a small proportion of them reported the use of mpUS in clinical practice. Participants in academic practices and from east region of China had greater self-reported use of mpMRI and mpUS and recommendation of MRI targeted biopsy.

Keywords: Prostate cancer (PCa); ultrasound (US); magnetic resonance imaging (MRI); biopsy; China

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Introduction

The standard procedure for prostate cancer (PCa) diagnosis is transrectal ultrasound-guided systematic biopsy, as recommended in the guidelines (1-3). However, this procedure is not without controversies. Significant concerns have been raised regarding the overtreatment of clinically insignificant prostate cancer (cisPCa) and the missed diagnosis of clinically significant prostate cancer (csPCa) (4-6). Additionally, the increasing number of puncture needles during systematic biopsy carries risks of complications, such as hematuria, erectile dysfunction, and post-biopsy infections (7,8). Therefore, investigating alternative strategy to reduce overtreatment and improve diagnostic accuracy is necessary.

In recent years, advances in medical imaging techniques lead to the widespread investigation of multiparametric magnetic resonance imaging (mpMRI) for risk assessment and PCa localization prior to biopsy (9-11). Additionally, multiparametric ultrasound (mpUS), which includes B-mode, color Doppler, elastography, and contrast-enhanced ultrasound, has been developed to improve PCa detection (12-14). Moreover, several studies from tertiary referral centers have confirmed that mpMRI-guided targeted biopsy or ultrasound-nuclear magnetic fusion image-guided targeted biopsy significantly improves the detection rate of PCa, reduces the number of biopsy cores, and lowers the risk of infection morbidity (5,15-17). These findings are be likely to have a significant impact on PCa clinical practice, promoting diagnostic accuracy and reducing overtreatment.

Currently, the incidence of PCa in Asia is gradually increasing, especially in China (18-21). However, little is known regarding the use of mpMRI and mpUS for PCa detection and biopsy in current practice in China, to the best of our knowledge. Therefore, a national survey from China was conducted among clinicians in this study to evaluate the perceived attitudes and practice patterns regarding mpMRI and mpUS for PCa diagnosis, as well as the relative use of prostatic systematic and targeted biopsies. We present this article in accordance with the CROSS reporting checklist (available at https://qims.amegroups.com/article/view/10.21037/qims-24-1834/rc).

Methods

This study used a cross-sectional design and was conducted in accordance with the Declaration of Helsinki and its subsequent amendments. The study was approved by the Medical Ethics Committee for the Sichuan Cancer Hospital and Institute (No. SCCHEC-02-2023-155) and individual consent for this study was waived due to the retrospective nature.

A questionnaire regarding mpMRI and mpUS on PCa detection and biopsy was designed to collect demographic information from clinicians, including urologists, radiologists, and sonographers. However, the decision-making regarding the execution of a prostate biopsy was entrusted to the urologist, who evaluated a broader range of clinical parameters prior to the biopsy. The survey questionnaire contained single- and multiple-choice items and was electronically delivered online with invitation links to a random sample of specialists from the Chinese Doctors Association of Ultrasound (CUDA), Chinese Anti-Cancer Association of Imaging (CACA-I), and Chinese Anti-Cancer Association of Genital Urology (CACA-GU). To recruit specialists in our survey sample, clinicians were selected who designated their primary specialty as ultrasonography, radiology, or urology. The recruitment period was from December 2023 to January 2024. Survey anonymity and confidentiality were ensured by not collecting personally identifiable information such as identification card numbers, names, telephone numbers, and physical addresses. Characteristics of all participants were obtained, including gender, ages, hospital practice types, and regions. Clinic

Table 1 Characteristics of participants (n=354)

Variables	Urologists (n=105)	Radiologist (n=121)	Ultrasonographer (n=128)	P value
Gender				<0.001
Male	98 (93.3)	91 (75.2)	47 (36.7)	
Female	7 (6.7)	30 (24.8)	81 (63.3)	
Age (years)				0.336
25–40	60 (57.1)	65 (53.7)	61 (47.7)	
>40	45 (42.9)	56 (46.3)	67 (52.3)	
Practice type				0.948†
Academic	58 (55.2)	65 (53.7)	68 (53.1)	
Community	43 (41.0)	50 (41.3)	51 (39.8)	
Private	4 (3.8)	6 (5.0)	9 (7.0)	
Region				0.840
Central-west	59 (56.2)	65 (53.7)	67 (52.3)	
East	46 (43.8)	56 (46.3)	61 (47.7)	

Data are presented as n (%). †, 2×3 Pearson Chi-squared test was performed between academic and community-private in row.

information was collected, including specialist perceptions of mpMRI and mpUS in the diagnosis of PCa, routine practice of prostate systematic biopsy and targeted biopsy, waiting time for appointment of these examinations, as well as their advantages and limitations.

After forming the initial questionnaire, three representative specialists (one urologist, one radiologist, and one ultrasonographer) with 8–10 years of experience in their primary specialty qualitatively reviewed and discussed the pilot survey to reach consensus. Next, a single e-mail included a cover letter and pilot survey was delivered to a random sample of 40 urologists, 40 radiologists, and 40 ultrasonographers for external validation. Lastly, the pilot questionnaire was finalized upon reviewing the responses and comments from the electronic survey.

Statistical analyses were performed using SPSS 26.0. Categorical variables are shown as numbers and percentages and analyzed using Pearson Chi-squared test. Univariable and multivariable logistic regression models were performed to identify characteristic variables of participants associated with response outcomes of survey items. Significance differences were defined as $P<0.05$.

Results

A total of 354 responses were received from 144 hospitals. The characteristics of participants are shown in *Table 1*. Specialties of participants were 29.7% in urologist, 34.2% in radiologist and 36.1% in sonographer; 53.9% of practice types were in academic hospitals. Except for gender, no significant differences were found in characteristics of participants. The distribution of questionnaire surveys across provinces throughout China are shown in *Figure 1*. The majority of them were located in western (41.8%) and eastern (46.0%) parts of China.

The overviews of participants' responses on the investigation questionnaire are shown in Table S1. Representative images of mpUS and mpMRI for PCa diagnosis are shown in *Figure 2*. Two hundred and thirty out of 322 (71.4%) participants used mpMRI to diagnose PCa, and 15.3% (38/248) of the participants used mpUS to diagnose PCa (*Figure 3A*). Regarding the purpose of using mpMRI and mpUS to examine the prostate, both were widely used for tumor staging, biopsy localization, active surveillance, and detection before and after treatment (*Figure 3B*). The use of mpUS was a preferable option in tumor screening. The deficiency of instruments and related expertise was the main cause for not conducting mpMRI and mpUS (*Figure 3C*). The secondary causes were cost for mpMRI and perceived useless for mpUS, respectively.

A large proportion of participants supposed that systematic biopsy (264/354, 74.6%) was preferable in the

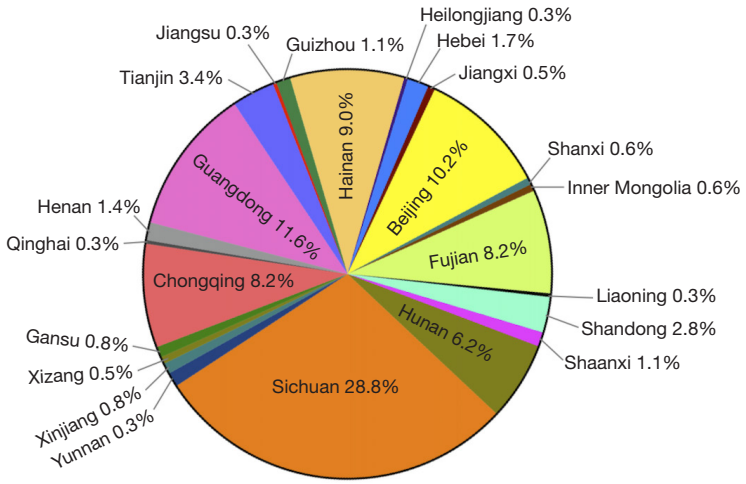

Figure 1 Distribution of participants throughout China.

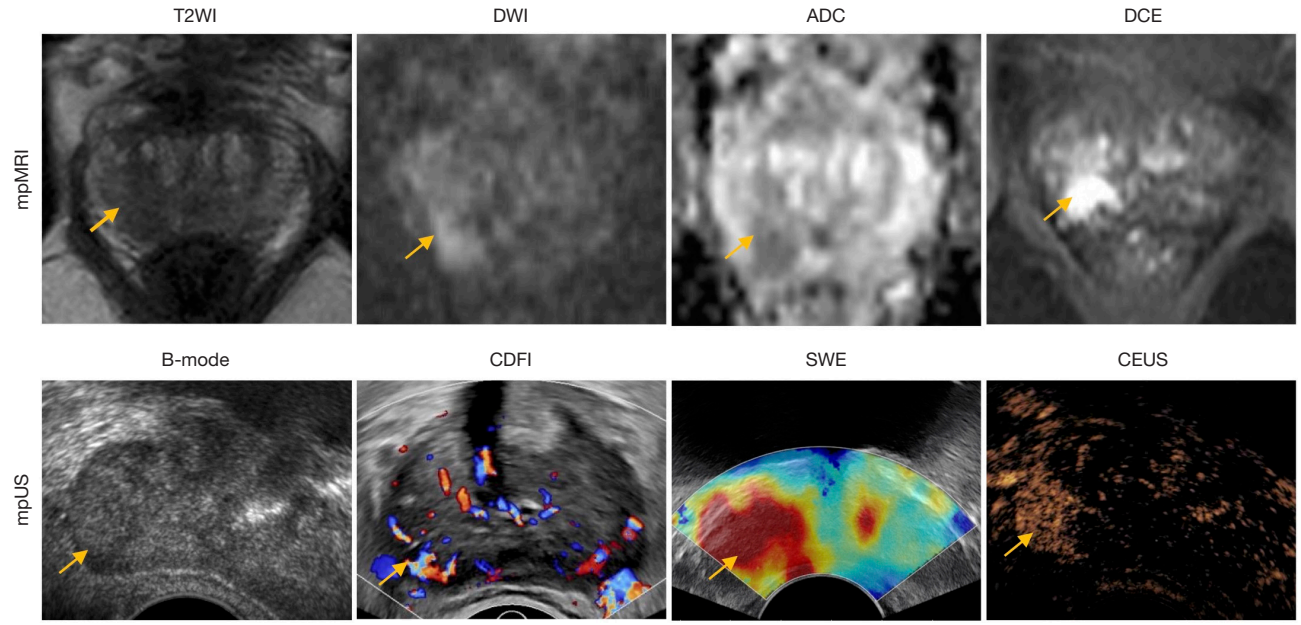

Figure 2 Representative images of mpMRI and mpUS. A 63-year-old man with PSA 18.5 ng/mL. The suspicious lesion in the right peripheral zone of prostate. mpMRI showed homogenous low signal intensity (arrow) in T2WI, localized high signal intensity (arrow) in DWI, low signal intensity (arrow) in ADC, and early enhancement (arrow) in DCE. mpUS showed iso-hypoechoic intensity (arrow) in B-mode, diffuse flow surrounding the lesion (arrow) in CDFI, hard stiffness (arrow) in SWE, and early enhancement (arrow) in CEUS. Follow-up histopathology revealed that a clinically significant prostatic cancer with Gleason score 4+3=7 was found in the right peripheral zone of prostate. ADC, apparent diffusion coefficient; B-mode, brightness-mode; CDFI, color Doppler flow image; CEUS, contrast-enhanced ultrasonography; DCE, dynamic contrast enhancement; DWI, diffusion weighted imaging; mpMRI, multiparametric magnetic resonance imaging; mpUS, multiparametric ultrasound; PSA, prostate-specific antigen; SWE, shear wave elastography; T2WI, T2 weighted imaging.

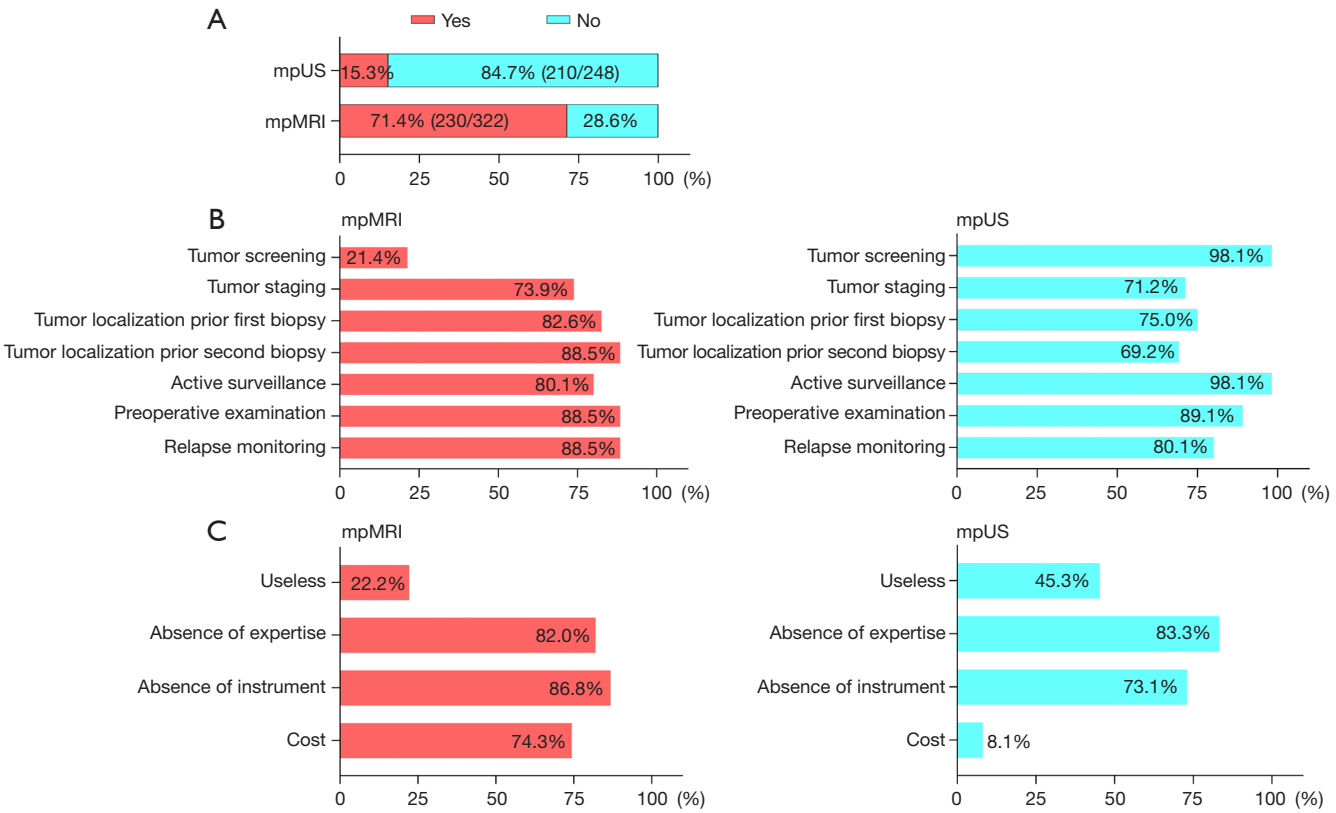

Figure 3 Selected questions for participants on mpMRI and mpUS of prostate examination. (A) The perceptions of specialists on use of mpMRI and mpUS for PCa diagnosis. (B) Analyses of purposes of using prostate mpMRI and mpUS. (C) Analyses of reasons for not using prostate mpMRI and mpUS. mpMRI, multiparametric magnetic resonance imaging; mpUS, multiparametric ultrasound; PCa, prostate cancer.

clinic practice with transperineal ultrasound guidance (167/354, 47.2%), as shown in *Figure 4A*. Cognitive fusion imaging (252/354, 71.2%) and MRI-US fusion imaging (220/354, 62.1%) were suggested as the primary modalities for targeted biopsy (*Figure 4B*). The majority of participants believed that MRI targeted biopsy is recommended (274/354, 77.4%) and is preferable to systematic biopsy (218/354, 61.6%) for the detection of prostate lesions (*Figure 4C*). Meanwhile, the equilibrium results were found in the mpUS targeted biopsy (*Figure 4C*). Simultaneously, the deficiency of instruments and related expertise was the main cause for not using MRI and mpUS-targeted biopsy, respectively (*Figure 4D*).

A large proportion of appointment was executed in less than 3 days, including 73.7% of mpUS examination, 78.2% of systematic biopsy, and 60.0% of mpUS-targeted biopsy (*Figure 4E*). However, a long waiting period for mpMRI and MRI-targeted biopsy was found, which was 39.6% and 83.4% in a week, respectively.

After using multivariable logistic regression analysis (*Table 2*), specialists had comparable consistent perceptions on PCa diagnosis and biopsy (all P>0.05). Clinic practice in the east region of China was more inclined to the utilization of mpMRI imaging [odds ratio (OR) =0.19; P<0.001] and recommendation of MRI-targeted biopsy (OR =0.15; P<0.001) for PCa detection. Higher ORs in agreeing mpMRI (OR =2.08; P=0.01) and MRI-targeted biopsy (OR =1.50; P=0.16) were obtained in participants from academic hospitals, compared to community and private practices. Furthermore, both practice in east region of China (OR =0.33; P=0.01) and participants from academic hospitals (OR =0.04; P<0.001) were independently associated with utilizing mpUS for PCa diagnosis. Conversely, no independent factors were found in univariable analysis regarding recommendation of mpUS-targeted prostate biopsy.

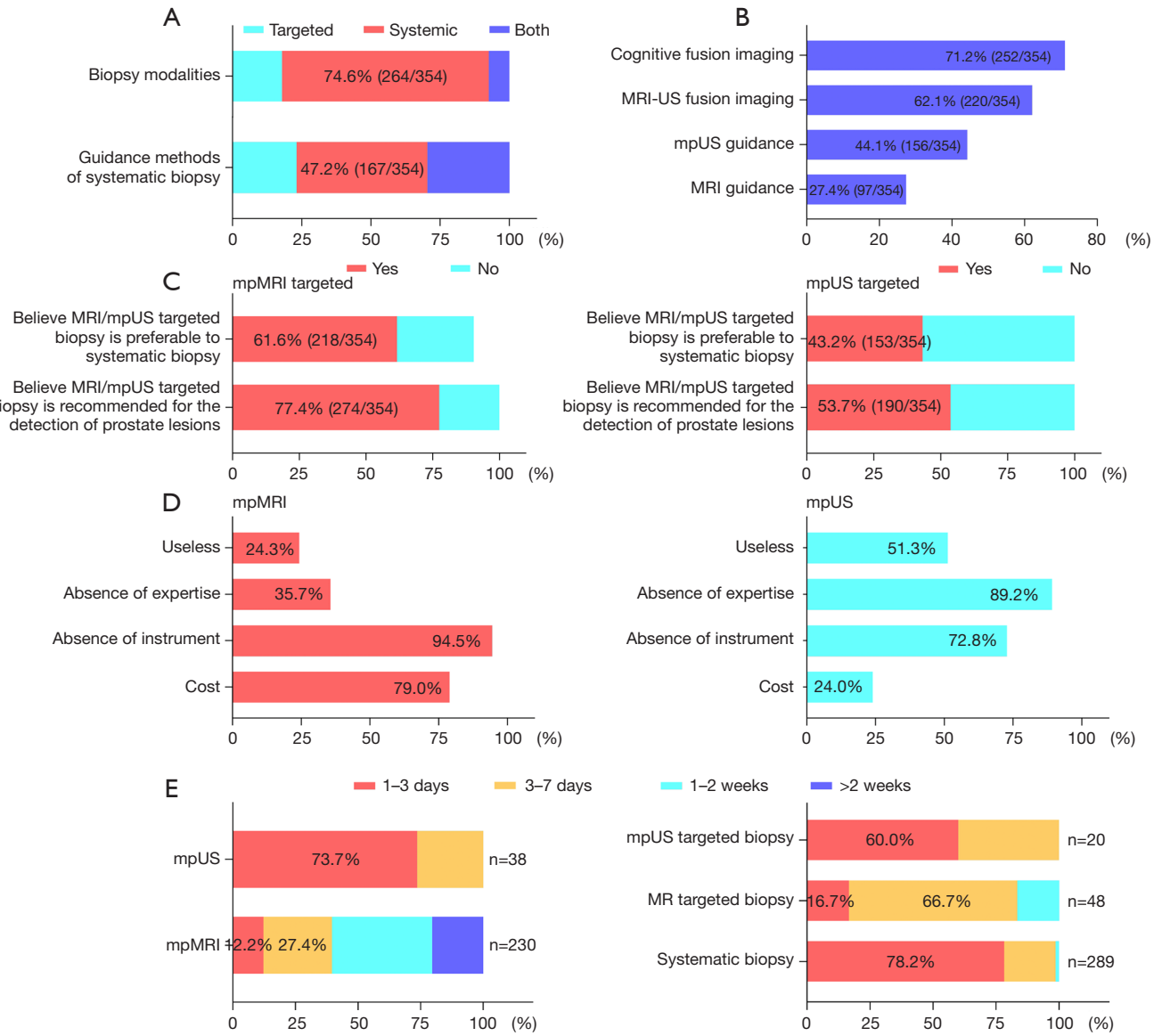

Figure 4 Selected questions for participants on prostate biopsies and appointment periods. (A) The distributions of biopsy modalities and guided approaches of systematic biopsy. (B) The distributions of targeted biopsy modalities. (C) The perceptions of specialists on mpMRI and mpUS targeted biopsy for detection of prostate cancer. (D) Analyses of reasons for not using mpMRI and mpUS targeted biopsy. (E) The waiting periods for appointment during examinations and biopsies. MR, magnetic resonance; MRI, magnetic resonance imaging; mpMRI, multiparametric magnetic resonance imaging; mpUS, multiparametric ultrasound; US, ultrasound.

Discussion

In this survey, a positive perception (73.9–88.5%) of prostatic mpMRI are detected for tumor staging, biopsy localization, active surveillance, and detection before and after treatment, which aligns with the recommendations of guidelines from American College of Radiology (ACR) (22), United Kingdom National Institute for Health and Care Excellence (NICE) at NICE web, and European Association of Urology (EAU)-European Association of Nuclear Medicine (EANM)-European Society for Radiotherapy and Oncology (ESTRO)-European Society of Urogenital Radiology (ESUR)-International Society of Geriatric Oncology (SIOG) (3). However, a large proportion (84.7%) of specialists do not use of mpUS, although a broad range of

Table 2 Uni- and multivariable logistic regression analysis

Covariates	Univariable analysis		Multivariable analysis	
	OR (95% CI)	P value	OR (95% CI)	P value
Do you use mpMRI for PCa diagnosis? (yes or no)				
Gender (male *vs.* female)	0.80 (0.46–1.39)	0.43	–	–
Age (≤40 *vs.* >40 years)	1.07 (0.66–1.75)	0.77	–	–
Specialty (urologist *vs.* radiologist *vs.* sonographer)				
Urologist	1.56 (0.83–2.93)	0.16	–	–
Radiologist	1.22 (0.70–2.14)	0.48	–	–
Sonographer	1	–	–	–
Hospital (academic *vs.* community & private)	1.78 (1.09–2.90)	0.02	2.08 (1.23–3.53)	0.01
Region (east *vs.* central-west)	0.20 (0.12–0.34)	<0.001	0.19 (0.11–0.32)	<0.001
Believe MRI targeted biopsy is recommended for the detection of prostate lesions (yes or no)				
Gender (male *vs.* female)	3.08 (1.84–5.15)	0.00	1.64 (0.92–2.92)	0.09
Age (≤40 *vs.* >40 years)	1.14 (0.69–1.88)	0.65	–	–
Specialty (urologist *vs.* radiologist *vs.* sonographer)				
Urologist	1.36 (0.74–2.49)	0.32	–	–
Radiologist	0.97 (0.53–1.80)	0.93	–	–
Sonographer	1	–	–	–
Hospital (academic *vs.* community & private)	1.79 (1.08–2.96)	0.02	1.50 (0.85–2.63)	0.16
Region (east *vs.* central-west)	0.13 (0.06–0.25)	<0.001	0.15 (0.07–0.30)	<0.001
Do you use mpUS for PCa diagnosis? (yes or no)				
Gender (male *vs.* female)	–	0.99	–	–
Age (≤40 *vs.* >40 years)	0.59 (0.29–1.19)	0.14	–	–
Specialty (urologist *vs.* radiologist *vs.* sonographer)				
Urologist	0.65 (0.26–1.65)	0.36	–	–
Radiologist	1.35 (0.61–3.01)	0.46	–	–
Sonographer	1	–	–	–
Hospital (academic *vs.* community & private)	0.05 (0.02–0.12)	<0.001	0.04 (0.02–0.11)	<0.001
Region (east *vs.* central-west)	0.45 (0.22–0.92)	0.29	0.33 (0.14–0.79)	0.01
Believe mpUS targeted biopsy is recommended for the detection of prostate lesions (yes or no)				
Gender (male *vs.* female)	0.65 (0.41–1.03)	0.07	–	–
Age (≤40 *vs.* >40 years)	0.80 (0.51–1.24)	0.32	–	–
Specialty (urologist *vs.* radiologist *vs.* sonographer)				
Urologist	0.80 (0.48–1.35)	0.41	–	–
Radiologist	0.89 (0.54–1.46)	0.64	–	–
Sonographer	1	–	–	–
Hospital (academic *vs.* community & private)	0.78 (0.50–1.22)	0.28	–	–
Region (east *vs.* central-west)	0.81 (0.52–1.27)	0.35	–	–

CI, confidence interval; MRI, magnetic resonance imaging; mpMRI, multiparametric magnetic resonance imaging; mpUS, multiparametric ultrasound; OR, odds ratio; PCa, prostate cancer.

usage purposes of mpUS are available, especially for tumor screening (98.1%), according to the perceived attitudes from those who used mpUS in the practice. Several studies (23,24), predominantly in the Europe and North American, have reported extensive utilization (85.7–95.9%) of prostatic mpMRI in their routine practice, which is higher than the percentage (71.4%) we reported in China. Compared to mpMRI, mpUS proposed subsequently has been considered useful in the detection of PCa in practice, such as contrast-enhanced ultrasound and elastography (25-27). The diagnostic efficacy of mpUS in detecting localized PCa appears to be on par with that of mpMRI. This is evidenced by comparable sensitivity rates (97.4% for mpUS versus 94.7% for mpMRI), negative predictive values (96.9% for mpUS versus 92.3% for mpMRI), and overall accuracy (87.2% for mpUS versus 76.9% for mpMRI) (13). Furthermore, mpUS has been associated with a lower cost-effectiveness profile compared to mpMRI in clinical practice (28). However, few national surveys have been published on perceptions of the use of prostatic mpUS in clinical practice. Our study is the first to report the practice patterns of prostatic mpUS in China. Nevertheless, more investigations are needed to explore the role of mpUS for PCa diagnosis.

In the current landscape of diagnostic imaging, prostate-specific membrane antigen (PSMA) positron emission tomography/computed tomography (PET/CT) has demonstrated a good accuracy (92%) for diagnosis and staging of high-risk PCa (29). Besides that, micro-ultrasound (micro-US), particularly when employed with a five-point scoring system known as prostate risk identification using micro-ultrasound (PRI-MUS), has been posited as an alternative to mpMRI for the detection of csPCa (30-32). Although this modality is not included in the scope of our survey, the advantages of micro-US are manifold: firstly, it serves to exclude the presence of csPCa in patients who exhibit persistent clinical suspicion despite negative mpMRI findings (33); secondly, a combined targeted biopsy approach utilizing both mpMRI and micro-US guidance has been shown to surpass systematic biopsy in terms of PCa and csPCa detection efficacy, while simultaneously reducing the incidence of unnecessary biopsies (34). Conversely, micro-US is not without its limitations: it may be constrained by large prostate volumes and the specific localization of tumors, such as those in the anterior or transitional zones (35). Additionally, when juxtaposed with mpMRI or mpUS, multifunctional imaging techniques (e.g., contrast-enhanced imaging, diffusion-weighted imaging, and elastography) are deficient for the discrimination of malignant lesions from benign anomalies (36). Given the dearth of comparative studies between micro-US and mpMRI/mpUS in the existing literature, there is a pressing need for more prospective, blinded studies to ascertain the role of micro-US and mpUS in the diagnostic algorithm for PCa detection.

The study exhibits a high recognition of the application of systematic biopsy (74.6%) with a transperineal approach and MRI-targeted biopsy with cognitive (71.2%) or US fusion (62.1%) approach in China, which accords with the international guideline-recommended transperineal approach to reduce the risk of sepsis and improve the detection rate for csPCa located in the anterior zone of gland (3,37). However, the majority (61.6–77.4%) of specialists propose that MRI-targeted biopsy is preferable to systematic biopsy for the recommendation of PCa detection, indicating a beneficial perspective on the technique over time. These results are consistent with those previous reported by Bukavina *et al.* and Saar *et al.* (23,38). In comparison, no obvious trend of mpUS-targeted biopsy is observed in the study, which might be attributed to merely a few proportions of participants using prostatic mpUS as a result of the deficiency of specialized instruments and related expertise in clinical practice (39,40). Pepe *et al.* have reported that mpUS did not enhance the accuracy of cognitive fusion biopsy (41). In contrast, other studies have validated the utility of this approach, demonstrating its efficacy in improving lesion visibility and facilitating the localization of csPCa (12,42,43). In addition, our study discloses a highly efficient performance on both mpUS examination and mpUS-targeted biopsy, in comparison with the long period of MRI appointment. Considering some aspects including low costs, real-time imaging, reliable applicability for patients with MRI contraindications are distinct merits of mpUS, this technique might exhibit good perspective in the future, but more randomized controlled trials directly comparing mpUS and mpMRI are warranted.

Regarding the primary impediments to the utilization of mpMRI and mpUS in the detection of PCa and targeted biopsy procedures, which include financial constraints and a dearth of expertise, potential remedial measures could encompass the development of specialized training programs, governmental financial incentives for the equipment procurement, and the fostering of public-private partnerships aimed at enhancing the accessibility of these resources. Furthermore, to augment the availability of advanced imaging modalities, such as mpUS and mpMRI,

in regions with limited access to healthcare, it is imperative to propose actionable recommendations for policymakers. These recommendations should encompass strategies like the integration of telemedicine services and the deployment of mobile diagnostic units to bridge the gap in healthcare delivery.

Several factors, including clinic practice in east region of China and from academic hospitals, show significant impacts on the use of mpMRI and mpUS as well as MRI-targeted biopsy for PCa diagnosis. Not only does clinic practice in east region of China tend to use mpMRI and mpUS, but such a setting is also predictive for an increased recommendation of MRI-targeted biopsy. In the meantime, greater use of mpMRI and mpUS as well as MRI-targeted biopsy is also confirmed from specialists in academic hospitals than those in communities and private organizations. This might contribute to greater availability and accessibility of high medical standards in economically prosperous regions (e.g., eastern region) and academically medical practices (e.g., affiliated hospital of university), demonstrating the technical interest and academic influence of participants from such areas. These findings are certainly supported to some degree by other studies, in which the use of prostatic mpMRI and MRI-targeted biopsy has been concentrated at academic medical centers and urban locations (38,44,45).

Limitations should be mentioned in the study. Firstly, based on the domestic scenarios of clinical practice, the electronic survey design has not been used in prior studies. However, the questionnaire was tested by a qualitative review and external validation to improve the reliability and validity of the findings. Secondly, since the electronic questionnaire was addressed online, a component of bias existed in specialists who might appeal to the technological topic of the survey. To reduce the reporting bias, we sent the questionnaire to more relevant specialists (urologists, radiologists, and sonographers) across various Chinese medical associations, in comparison with a solo organization opted in the previous reports (23,46,47). Thirdly, a small sample size with a relative low response rate of 23.6% may limit the generalizability of the study. To decrease sample bias, the specialist samples were randomized from the Chinese medical associations, and a slightly higher response rate was obtained compared to other publications (with most surveys having response rates <10%) (47,48). In addition, the study primarily focused on the mpMRI and mpUS in China, with limited comparisons to international practices and insufficient details on non-participants. Therefore, the generalization of these results is limited to the overall prostate diagnosis represented by these communities in China. Specifically, the cross-sectional survey results merely reflect the present overview. Longitudinal data should be studied to provide insights into trends and changes in the use of mpMRI and mpUS over time. Despite these limitations, this study provides the first perceptions of Chinese specialists on the practice patterns of prostatic mpMRI and mpUS as well as biopsies. It would be useful to recognize the status in quo of PCa detection in China and observe the evolvement of these perceptions and practice patterns over time.

Conclusions

This survey indicates that mpMRI and transperineal ultrasound-guided systematic biopsy are relatively commonly used for PCa diagnosis in clinical practice in China. Meanwhile, MRI-targeted biopsy is also recommended by most participants. However, prostatic mpUS is used only by a fraction of participants. Except for mpUS targeted biopsy, these techniques are most commonly used in practice settings in east region of China and academic hospitals.

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None.

Footnote

Reporting Checklist: The authors have completed the CROSS reporting checklist. Available at https://qims.amegroups.com/article/view/10.21037/qims-24-1834/rc

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related

to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki and its subsequent amendments. The study was approved by the Medical Ethics Committee of the Sichuan Cancer Hospital and Institute (No. SCCHEC-02-2023-155) and individual consent for this study was waived due to the retrospective nature.

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